

(10) **Patent No.:** US 9,349,553 B2  
(45) **Date of Patent:** May 24, 2016

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,065,276	A *	11/1991	Chou .....	361/820
6,825,430	B2 *	11/2004	Wong et al. ....	200/547
6,841,744	B1 *	1/2005	Kodo et al. ....	200/16 C
7,507,926	B2 *	3/2009	Kawamura et al. ....	200/548
7,800,008	B2 *	9/2010	Shi et al. ....	200/547
8,080,757	B2 *	12/2011	Zuo .....	200/548
8,319,135	B2 *	11/2012	Chen et al. ....	200/547
8,598,479	B2 *	12/2013	Quan et al. ....	200/293
02/0175061	A1 *	11/2002	Shinkawa .....	200/252
07/0278084	A1 *	12/2007	Kawamura et al. ....	200/531
0/0072041	A1 *	3/2010	Zuo .....	200/17 R
2/0241295	A1 *	9/2012	Huang .....	200/330
3/0256104	A1 *	10/2013	Fujita et al. ....	200/252

2002/0175061	A1 *	12/2002	Shin et al. ....	200/252
2007/0278084	A1 *	11/2007	Kankawa ....	200/252
2010/0072041	A1 *	3/2010	Kawamura et al. ....	200/531
2012/0241295	A1 *	9/2012	Zuo ....	200/17 R
2013/0256104	A1 *	10/2013	Huang ....	200/330
			Fujita et al. ....	200/252

FOREIGN PATENT DOCUMENTS

JP 2013-20739 1/2013

\* cited by examiner

*Primary Examiner* — Renee Luebke

*Assistant Examiner — Ahmed Saeed*

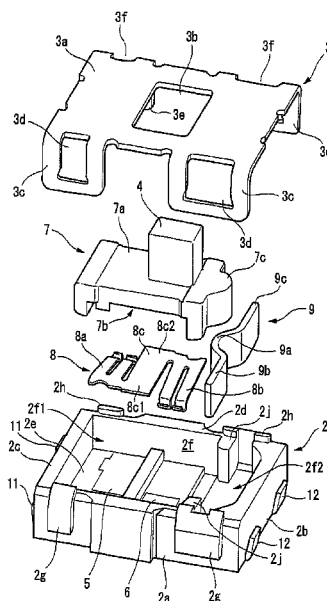
(74) *Attorney, Agent, or Firm* — Whitham, Curtis, Christofferson & Cook, P.C.

(57) **ABSTRACT**

A slide switch includes a case forming an accommodation space, a first contact disposed in the accommodation space, a second contact disposed in the accommodation space, a third contact disposed in the accommodation space, and a slider fixed to the third contact. The slider is movable between a first position in which the first contact and the second contact are electrically insulated from each other and a second position in which the first contact and the second contact are electrically connected to each other via the third contact. The case includes a projection supporting the third contact in a normal direction of a plane which includes a moving path of the slider in the accommodation space.

**5 Claims, 7 Drawing Sheets**

(58) **Field of Classification Search**  
CPC ..... H01H 1/365; H01H 1/44; H01H 15/02  
USPC ..... 200/252, 257, 260, 547-550  
See application file for complete search history.



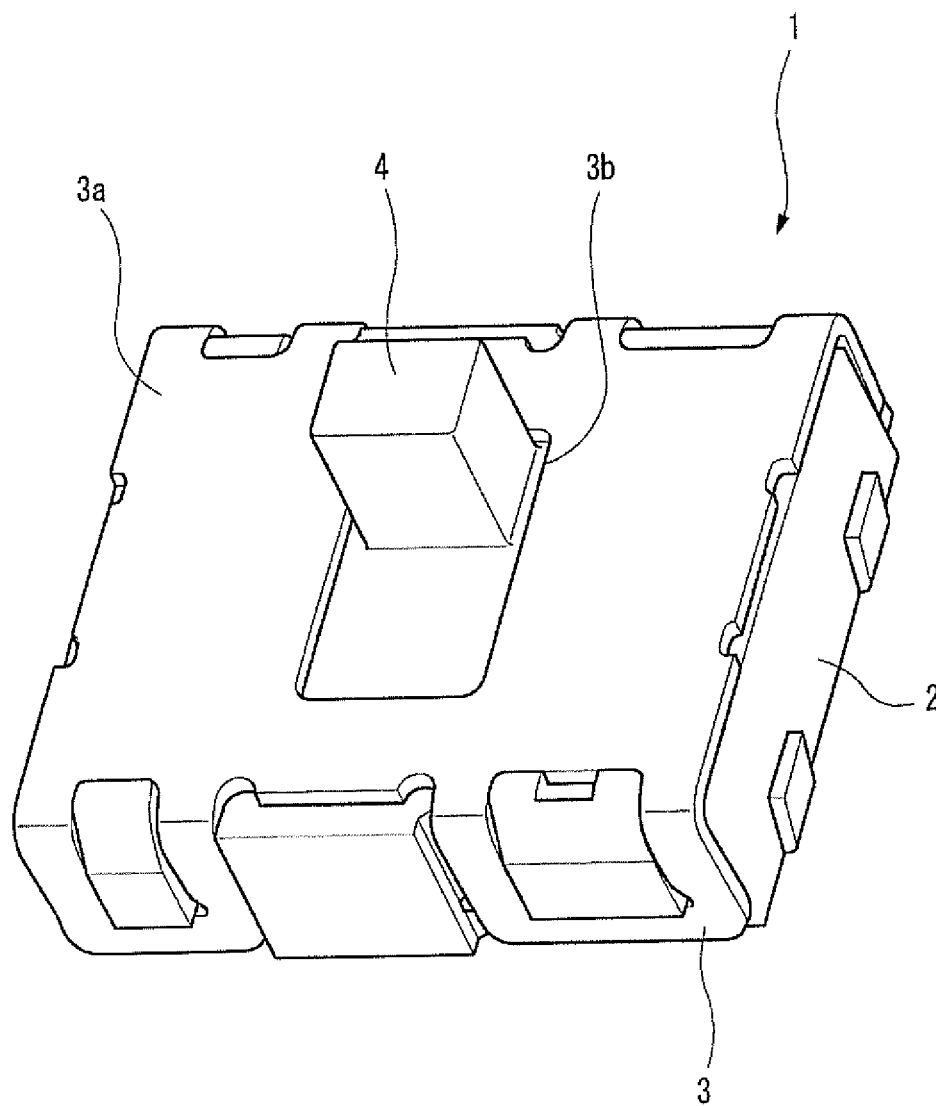
*Fig. 1*

Fig. 2

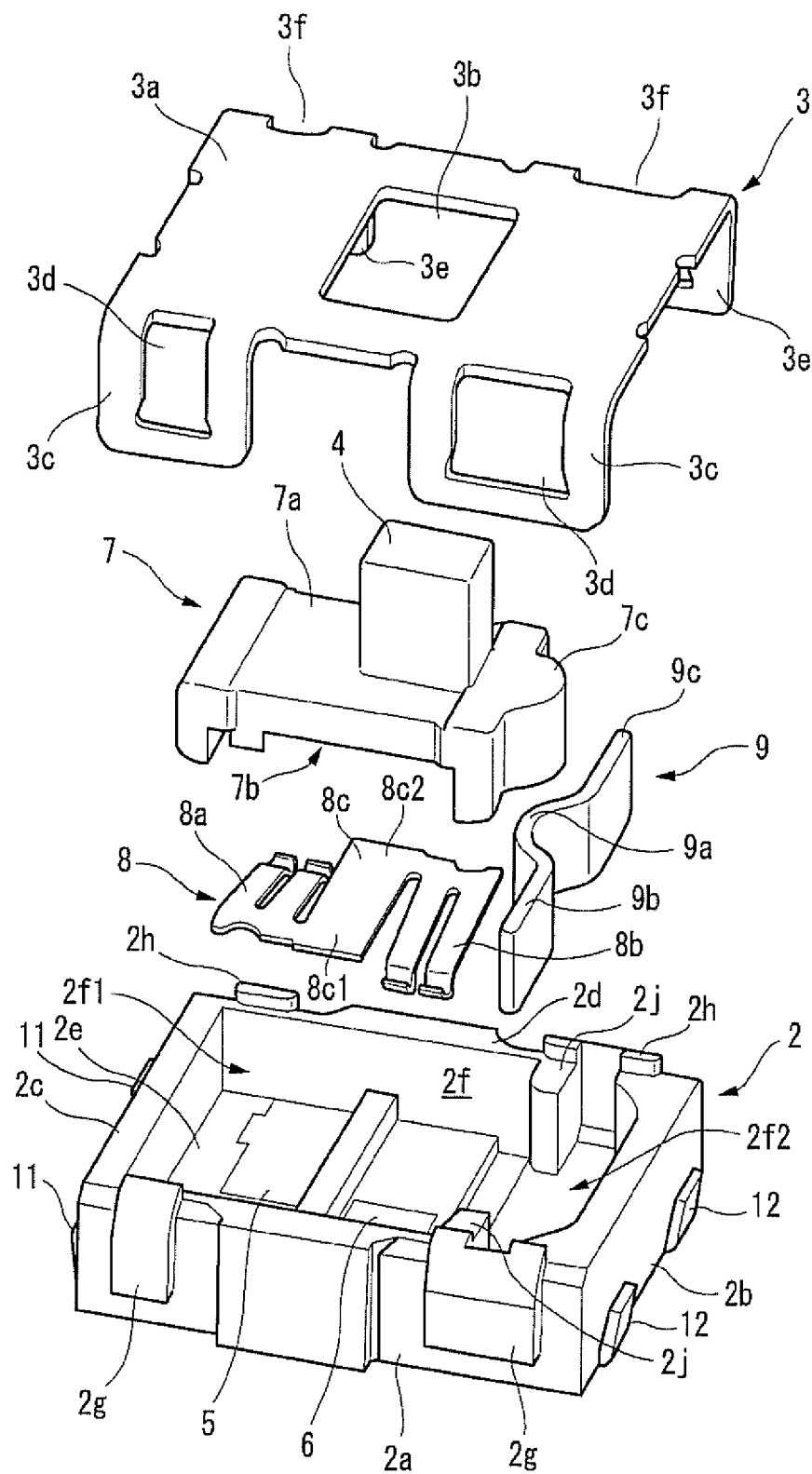


Fig. 3

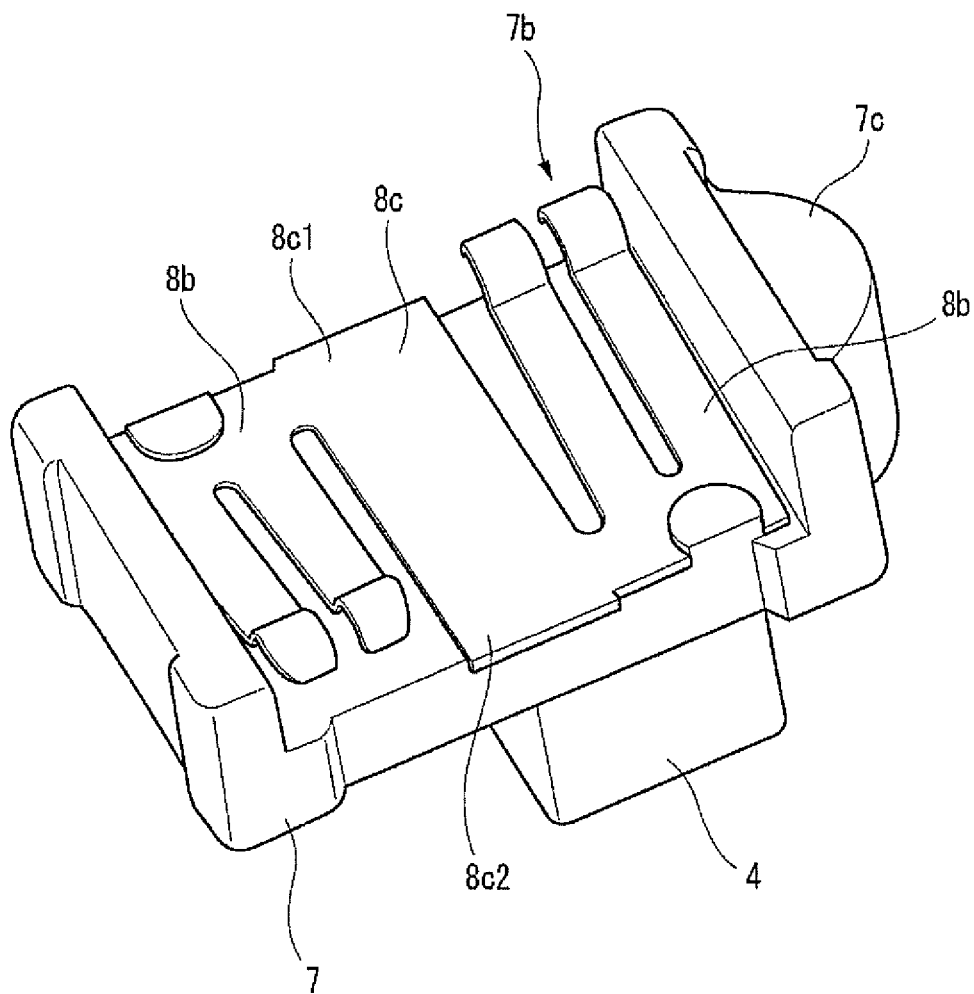


Fig. 4A

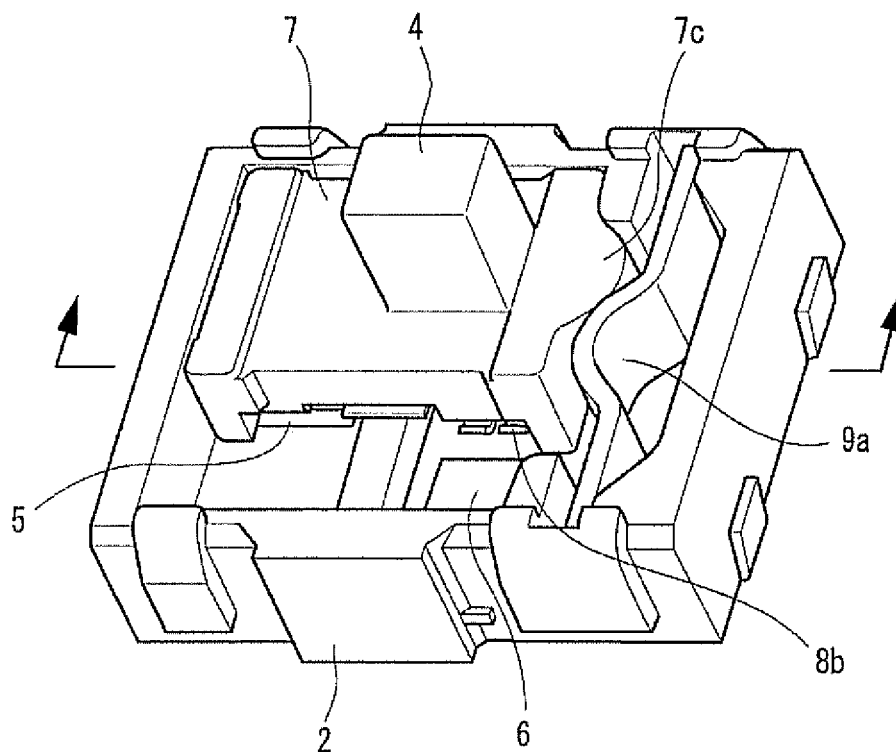


Fig. 4B

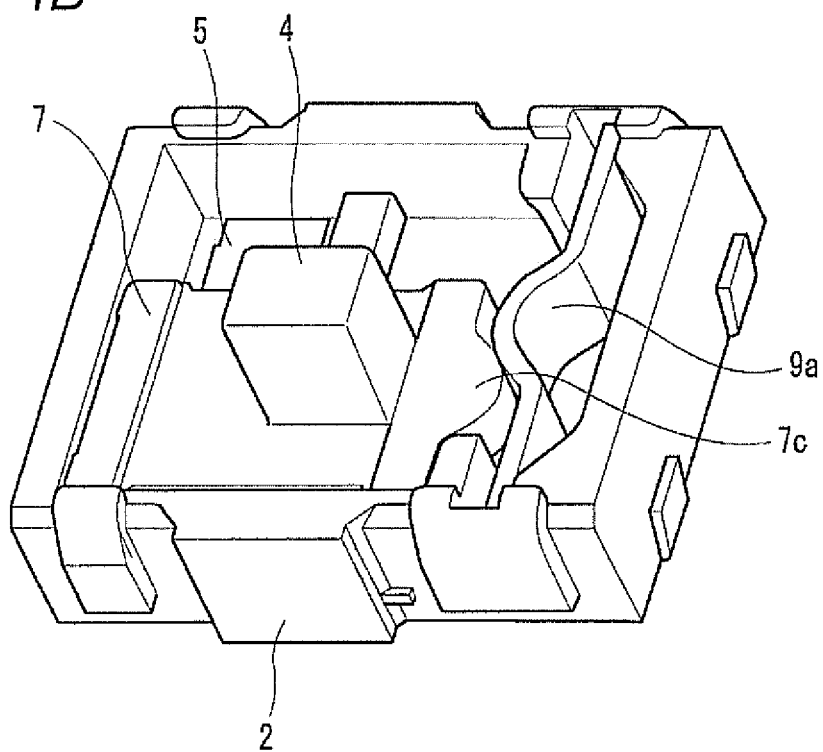


Fig. 5A

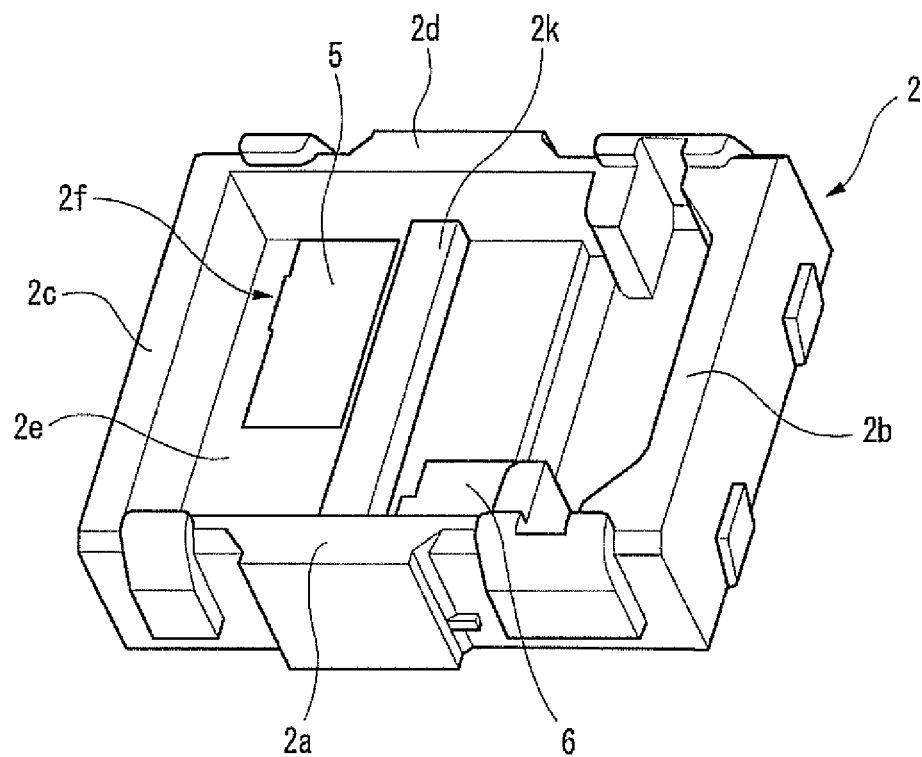
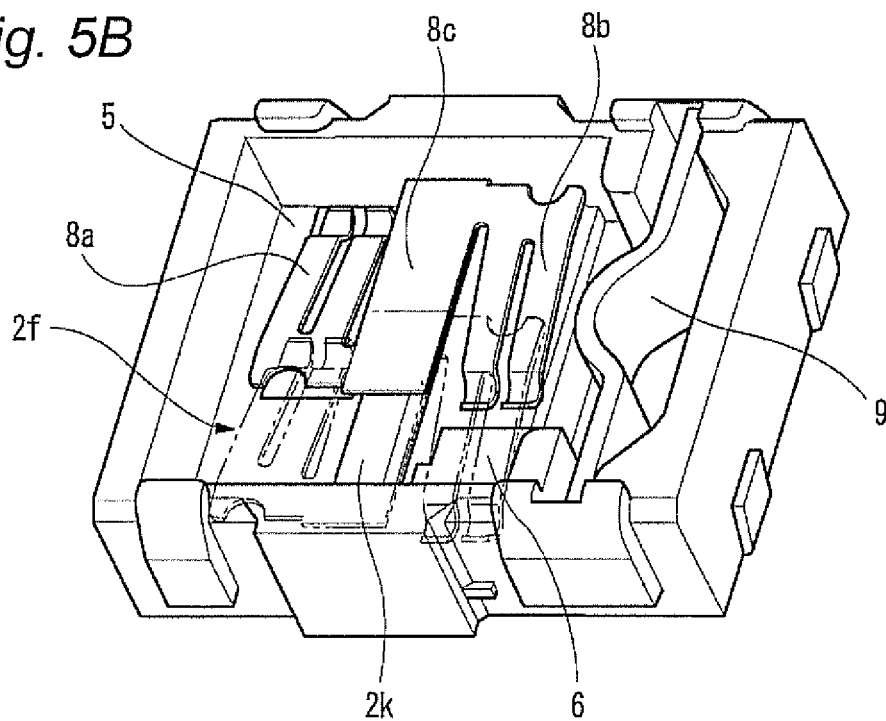


Fig. 5B



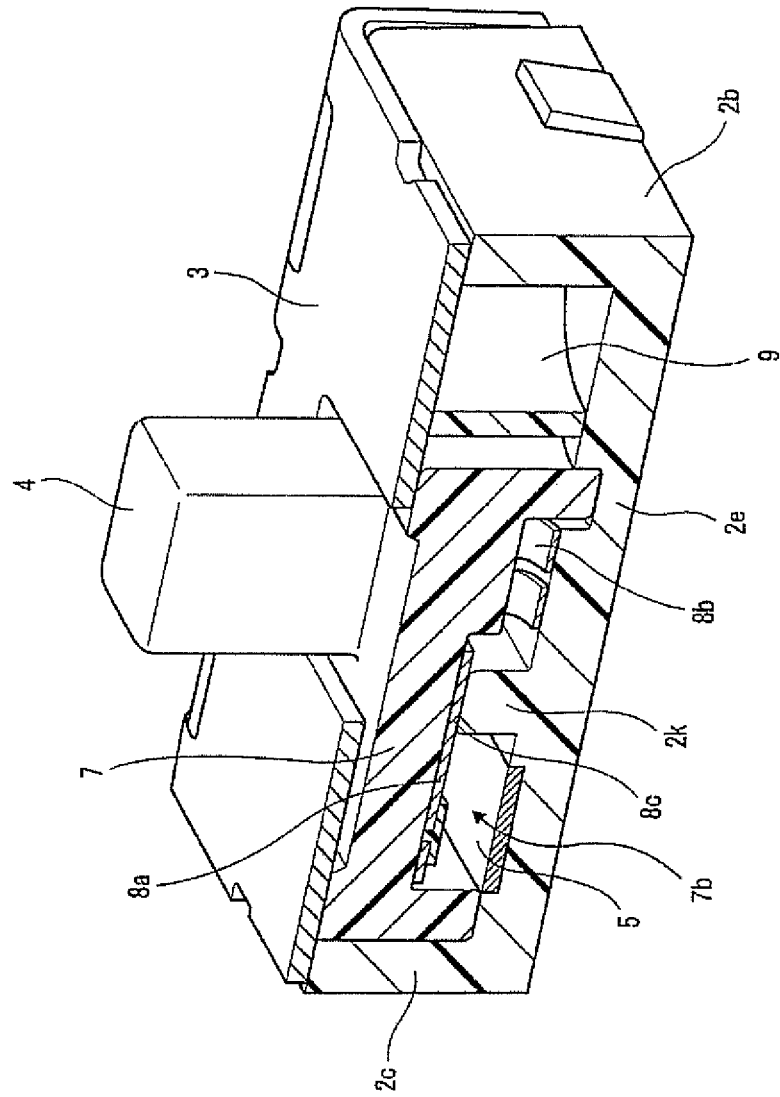


Fig. 6

Fig. 7A

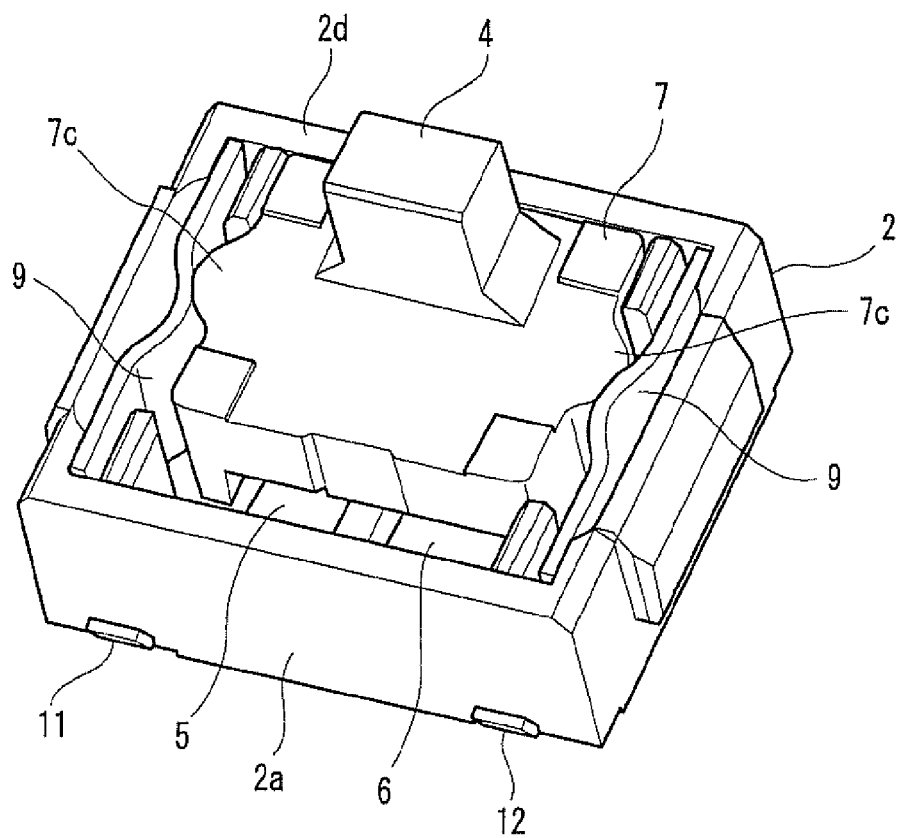
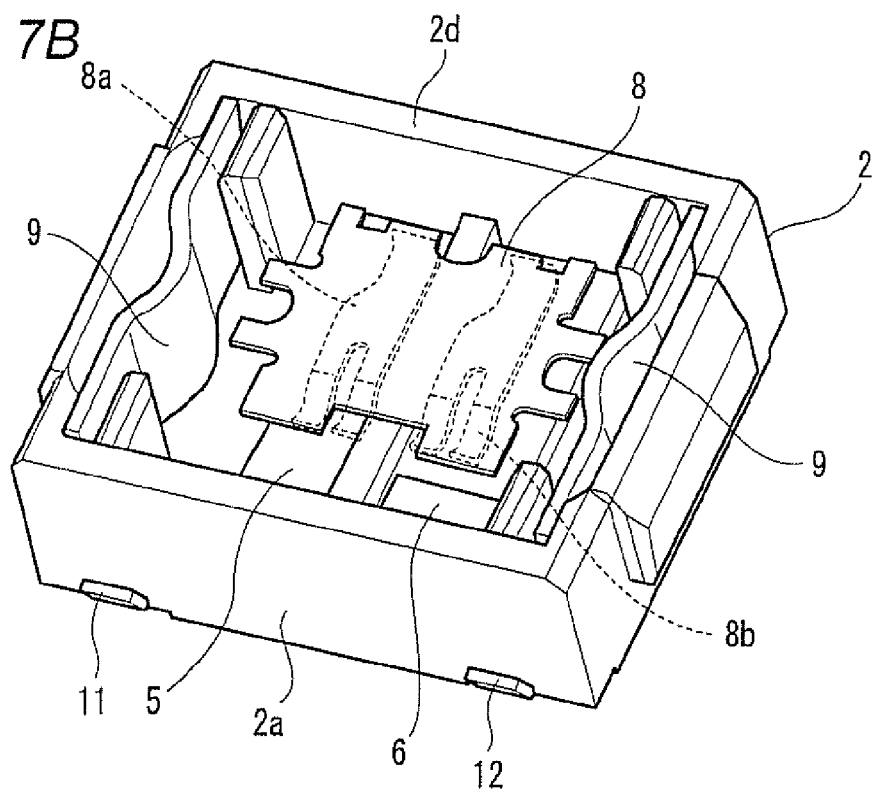


Fig. 7B



# 1

## SLIDE SWITCH

### BACKGROUND

The present invention relates to a slide switch.

A slide switch includes a case that defines an accommodation space. A first contact and a second contact are disposed inside the accommodation space as fixed contacts. A third contact as a movable contact is fixed to a slider and disposed inside the accommodation space. The slider is movable between a first position in which the first contact and the second contact are electrically insulated from each other and a second position in which the first contact and the second contact are electrically connected to each other via the third contact (refer to Patent Document 1).

[Patent Document 1] JP-A-2013-20739

### SUMMARY

It is therefore one advantageous aspect of the present invention to provide a slide switch in which defects such as a conduction failure can be prevented even when the sizes of the parts of the slide switch are reduced.

According to one aspect of the invention a slide switch, comprising:

- a case forming an accommodation space;
- a first contact disposed in the accommodation space;
- a second contact disposed in the accommodation space;
- a third contact disposed in the accommodation space; and
- a slider fixed to the third contact, wherein

the slider is movable between a first position in which the first contact and the second contact are electrically insulated from each other and a second position in which the first contact and the second contact are electrically connected to each other via the third contact, and

the case includes a projection supporting the third contact in a normal direction of a plane which includes a moving path of the slider in the accommodation space.

The slide switch may be configured such that: the third contact includes a first portion, a second portion, and a third portion; the first portion and the second portion are displaceable in the normal direction; the third portion is disposed between the first portion and the second portion and fixed to the slider; and the projection supports the third portion.

The slide switch may be configured such that: the third portion extends so that a longitudinal direction of the third portion is a movement direction of the slider; the first portion is supported in a cantilever beam form in a first end portion in the longitudinal direction of the third portion; the second portion is supported in a cantilever beam form in a second end portion in the longitudinal direction of the third portion; the first portion extends from the first end portion to the second end portion, in one direction; and the second portion extends from the second end portion to the first end portion, in one direction.

The slide switch may be configured such that: a recess portion recessed in the normal direction is formed on the slider; and the third contact and the projection is disposed in the recess portion.

The slide switch may be configured such that the projection extends across the overall movable range of the slider along a movement direction of the slider.

### BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective view showing an external appearance of a slide switch according to an embodiment of the invention.

# 2

FIG. 2 is an exploded perspective view showing the slide switch.

FIG. 3 is a perspective view showing a movable contact fixed to a slider which is included in the slide switch.

FIGS. 4A and 4B are views illustrating a movement of the slider.

FIGS. 5A and 5B are views illustrating a protrusion that supports the movable contact.

FIG. 6 is a cross-sectional view taken along the line IV-IV in FIG. 4A.

FIGS. 7A and 7B are perspective views showing a part of the slide switch according to a modification example.

### DETAILED DESCRIPTION OF EXEMPLIFIED EMBODIMENTS

In general, a movable contact is fixed to a slider by crimping or the like. As the size of a switch is required to be reduced, it is inevitable that the sizes of element parts, such as the slider and the movable contact, are reduced. For this reason, a structural strength that is sufficient for the movable contact on the slider cannot be ensured, and there is a case where a positional displacement or a backlash of the movable contact occurs. As a result, defects such as a conduction failure can be caused.

An object of the present invention is to provide a technology that can prevent defects such as a conduction failure, even when the sizes of the parts that configure a structure of a slide switch are reduced.

With reference to the attached drawings, an example of an embodiment according to the invention will be described in detail. In each drawing used for following description, a scale is appropriately changed so as to make the size of each member recognizable. In addition, expressions such as back, forth, right, left, up and down are used for convenience of description, and do not limit postures or directions in actual use conditions.

FIG. 1 is a perspective view showing an external appearance of a slide switch 1 according to an embodiment of the invention. The slide switch 1 includes a case 2, a cover 3, and an operation portion 4. The case 2 is formed from an insulating material and configured to be mounted on a circuit substrate. The cover 3 is formed from a conductive material and installed on the case 2. An opening 3b is formed to extend in a back-and-forth direction on an upper surface 3a of the cover 3. The operation portion 4 is formed from an insulating material and extends in an up-and-down direction through the opening 3b.

FIG. 2 is an exploded perspective view showing the slide switch 1. The slide switch 1 includes the case 2, the cover 3, and the operation portion 4, and further includes a first fixed contact 5, a second fixed contact 6, a slider 7, a movable contact 8, a retainer plate 9, a first connection terminal 11, and a second connection terminal 12.

The case 2 includes a front wall 2a, a right wall 2b, a left wall 2c, a rear wall 2d, and a bottom wall 2e. An accommodation space 2f is defined by these walls 2a to 2e. A plurality of locking projections 2g are formed on the front wall 2a. A plurality of locking projections 2h are formed on the rear wall 2d. A division wall 2j is formed in the accommodation space 2f. The division wall 2j divides the accommodation space 2f into a first accommodation portion 211 and a second accommodation portion 212.

The first fixed contact 5 (a first contact) is formed from a conductive material. The first fixed contact 5 is disposed on the bottom wall 2e close to the rear wall 2d in the first accommodation portion 211. The second fixed contact 6 (a second

contact) is formed from a conductive material. The second fixed contact 6 is disposed on the bottom wall 2e close to the front wall 2a in the first accommodation portion 2/1.

The first fixed contact 5 is electrically connected with the first connection terminal 11 disposed on an outer side of the left wall 2c. The second fixed contact 6 is electrically connected with the second connection terminal 12 disposed on an outer side of the right wall 2b. When the slide switch 1 is mounted on the circuit substrate (not shown), the first connection terminal 11 and the second connection terminal 12 are electrically connected with contacts formed on the circuit substrate. Electric connection with the contact is performed by soldering or the like.

The slider 7 is formed from an insulating material. The above-described operation portion 4 is provided on an upper surface 7a of the slider 7. A recess portion 7b is formed in a lower part of the slider 7. In a right side part of the slider 7, a semicylindrical projection 7c is formed.

The movable contact 8 (a third contact) is formed from a conductive material. The movable contact 8 includes a first arm 8a (a first portion of the third contact), a second arm 8b (a second portion of the third contact), and a base 8c (a third portion of the third contact). The base 8c is disposed between the first arm 8a and the second arm 8b.

The first arm 8a is supported by a front end portion 8c1 (a first end portion of the third portion) of the base 8c in a cantilever beam form. The second arm 8b is supported by a rear end portion 8c2 (a second end portion of the third portion) of the base 8c in a cantilever beam form.

As shown in FIG. 3, the movable contact 8 is fixed in the recess portion 7b of the slider 7. In the embodiment, crimping is performed in the base end portion of the first arm 8a and the second arm 8b that are respectively supported by the base 8c in a cantilever beam form, accordingly, the base 8c is fixed to the slider 7. Meanwhile, a tip end portion of the first arm 8a and the second arm 8b, respectively, is allowed to be displaced.

The retainer plate 9 is formed from a material having elasticity. As shown in FIG. 2, the retainer plate 9 includes a curved portion 9a and flat portions 9b and 9c which are connected to both sides of the curved portion 9a. The retainer plate 9 is fixed in the second accommodation portion 2/2 in a posture, in which the flat portions 9b and 9c extend in the back-and-forth direction, facing a convex side of the curved portion 9a toward a side of the first accommodation portion 2/1.

FIG. 4A shows a state where the slider 7 to which the movable contact 8 is fixed and the retainer plate 9 are disposed in the accommodation space 2f. In this position, the tip end portion of the first arm 8a of the movable contact 8 fixed to the lower part of the slider 7 is contacted with the first fixed contact 5. Meanwhile, the tip end portion of the second arm 8b of the movable contact 8 is not contacted with the second fixed contact 6. That is, in a case where the slider 7 is disposed on the position, the first fixed contact 5 and the second fixed contact 6 are electrically insulated (a first position). In this case, the projection 7c of the slider 7 abuts against the curved portion 9a of the retainer plate 9, and the displacement from the position shown in the drawing is controlled.

By applying a force which is equal to or higher than a constant value to the operation portion 4 toward the front, the projection 7c deforms the retainer plate 9 and moves over the curved portion 9a. The slider 7 gives an operator a moderate feeling and moves to the position shown in FIG. 4B. In this case, the tip end portion of the first arm 8a of the movable contact 8 is sequentially contacted with the first fixed contact 5. Meanwhile, the tip end portion of the second arm 8b of the

movable contact 8 is also contacted with the second fixed contact 6. That is, in a case where the slider 7 is disposed on the position, the first fixed contact 5 and the second fixed contact 6 are electrically connected via the movable contact 8 (a second position). The curved portion 9a of the retainer plate 9 returned to an original shape abuts against the projection 7c, and thus the displacement of the slider 7 from the position is controlled.

As shown FIG. 2, the cover 3 includes a plurality of arms 3c extending downward from the front end portion. Locking holes 3d are formed on each of the arms 3c. The cover 3 further includes a plurality of arms 3e extending downward from the rear end portion. Locking holes 3f are formed on each of the arms 3e. By covering the case 2 with the cover 3 in a state shown in FIGS. 4A and 4B, the locking projections 2g and 2h of the case 2 are respectively engaged with the locking holes 3d and 3f of the cover 3. Accordingly, the cover 3 closes the accommodation space 2f and is fixed to the case 2. The operation portion 4 can be displaced in the opening 3b of the case 3, according to the movement of the slider 7.

As shown in FIG. 5A, a protrusion 2k (a projection) is formed on the bottom wall 2e of the case 2. The protrusion 2k extends between the first fixed contact 5 and the second fixed contact 6, along the back-and-forth direction, that is, the movement direction of the slider 7.

FIG. 5B shows a position relation between the movable contact 8 and the protrusion 2k in a state where the slider 7 fixed to the movable contact 8 is disposed in the first accommodation portion 2/1. The position shown by the solid line responds to a state where the slider 7 is disposed at the position shown in FIG. 4A. The position shown by the two-dot chain line responds to a state where the slider 7 is disposed at the position shown in FIG. 4B. FIG. 6 shows a cross section taken along the line IV-IV in FIG. 4A.

As clarified by the drawings, the protrusion 2k supports the movable contact 8 from below. In other words, the protrusion 2k supports the movable contact 8 from a normal direction of a plane including a moving path of the slider 7. Therefore, even in a case where the size of the slide switch 1 is reduced and a structural strength that fixes the movable contact 8 to the slider 7 is not sufficiently ensured, it is possible to retain the movable contact 8 at an original position.

Accordingly, it is possible to prevent a conduction failure caused by a positional displacement and a backlash of the movable contact 8 over a long period of time. In addition, since the position of the movable contact 8 is stabilized, it is possible to stabilize contact resistance between the first fixed contact 5 and the second fixed contact 6. Moreover, it is possible to suppress chattering caused by vibration.

A front end of the protrusion 2k is connected with an inner surface of the front wall 2a (not shown in the drawing), and a rear end of the protrusion 2k is connected with an inner surface of the rear wall 2d. That is, the protrusion 2k extends across the overall movable range of the slider 7. As a result, regardless of the position of the slider 7, it is possible to support the movable contact 8 at the original position.

More specifically, the protrusion 2k supports the base 8c of the movable contact 8 fixed to the slider 7. Therefore, it is possible to reliably support the movable contact 8 at the original position, while allowing a displacement of the first arm 8a and the second arm 8b in the normal direction.

As shown FIGS. 2 and 3, the base 8c of the movable contact 8 extends so that a longitudinal direction of the base 8c is the movement direction of the slider 7. The first arm 8a of the movable contact 8 is supported in the front end portion 8c1 of the base 8c in a cantilever beam form and extends to the rear end portion 8c2 of the base 8c, in one direction. The second

5

arm **8b** of the movable contact **8** is supported in the rear end portion **8c2** of the base **8c** in a cantilever beam form and extends to the front end portion **8c1** of the base **8c**, in one direction.

Here, the expression “extend in one direction” is used in order to distinguish the configuration of the invention from a movable contact configuration described in Patent Document 1 which has a folded part between the base end and the tip end of the arm supported in a cantilever beam form.

According to the movable contact **8** of the embodiment, it is possible to sufficiently ensure flexibility of the first arm **8a** and the second arm **8b**, and reduce the dimension of the movable contact in an up-and-down direction (that is, the normal direction of a surface including the movement direction of the slider **7**) to be smaller than the dimension of a movable contact described in Patent Document 1. Therefore, the size of the slide switch **1** can be smaller.

As shown in FIG. 6, the recess portion **7b** of the slider **7** is recessed in the above-described normal direction, and the protrusion **2k** and the movable contact **8** are disposed in the recess portion **7b**. Accordingly, it is possible to make the slide switch **1** thin.

The above-described embodiment is used to make understanding the invention easier, and does not limit the invention thereto. The invention can be changed and improved insofar as there is no departure from the scope of the invention, and also can include the invention equivalents.

The number of the fixed contacts disposed in the accommodation space **2f** of the case **2** is not limited to two. For example, when three fixed contacts A, B, and C are arranged on the moving path of the slider **7** and the three fixed contacts are disposed at a position of the slider **7**, the fixed contacts A and B may have a configuration to be conducted via the movable contact. When the slider **7** is disposed at a different position from the three fixed contacts A, B, and C, the fixed contacts B and C may have a configuration to be conducted via the movable contact. It is apparent that the more number of fixed contacts may be provided.

The cover **3** installed on the case **2** does not require to be formed from a conductive material. As long as the arms **3c** and **3e** have elasticity, the cover **3** may be formed from an insulating material such as resin or the like.

The projection **7c**, similar to the projection **7c** on the right side portion, may also be formed on the left side portion of the slider **7**. The configuration also may have one more retainer plate **9** at a position facing the left side portion of the slider **7**. An example of such a configuration is shown in FIG. 7A. In this case, if the load added to the slider **7** is the same, the load applied to each of the retainer plates **9** can be reduced by half. Therefore, it is possible to improve a tolerance to the high load that can be added to the slider **7** through the operation portion **4**, and extend the longevity of products.

In addition, the shape and the placement of the first fixed contact **5**, the second fixed contact **6**, the movable contact **8**, the first connection terminal **11**, and the second connection terminal **12** can be appropriately changed according to the specification of the switch.

For example, as shown in FIG. 7B, in the modification example of the invention, both the first fixed contact **5** and the second fixed contact **6** are disposed close to the front wall **2a** of the case **2**. The rear end portion of the first fixed contact **5** is disposed closer to the rear wall **2d** of the case **2** than the rear end portion of the second fixed contact **6**. Meanwhile, both the first arm **8a** and the second arm **8b** of the movable contact **8** according to the modification example of the invention are supported in the rear end portion side of the movable contact **8** in a cantilever beam form, and extend to the front end portion.

Therefore, in a case where the slider **7** is disposed at a position shown in FIG. 7A, only the first arm **8a** contacts with

6

the first fixed contact **5**, and the first fixed contact **5** and the second fixed contact **6** are electrically insulated (a first position). When the slider **7** moves toward the front wall **2a**, the second arm **8b** comes into contact with the second fixed contact **6**. As a result, the first fixed contact **5** and the second fixed contact **6** are electrically connected via the movable contact **8** (a second position).

The first connection terminal **11** is disposed on the outer side of the front wall **2a** and electrically connected with the first fixed contact **5**. Not shown in drawings, but the similar first connection terminal **11** is also disposed on the outer side of the rear wall **2d**. The second connection terminal **12** is disposed on the outer side of the front wall **2a** and electrically connected with the second fixed contact **6**. Not shown in drawings, but the similar second connection terminal **12** is also disposed on the outer side of the rear wall **2d**.

The projection **7c** of the slider **7** does not require to be formed in a semicylindrical shape. As long as the position of the slider **7** is restricted by the retainer plate **9** and the retainer plate **9** can be changed according to the displacement of the slider **7**, the projection **7c** can be made in an appropriate shape, such as a hemisphere or the like.

The base **8a** of the movable contact **8** does not require to be fixed to the slider **7** by crimping. Only when the displacement of the movable contact **8** with respect to the slider **7** is prevented, it is possible to employ an appropriate fixing method, such as pressing or the like.

In the invention, even in a case where the size of the slide switch is reduced and the structural strength that fixes the third contact to the slider is not sufficiently ensured, it is possible to support the third contact at an original position. Accordingly, it is possible to prevent a conduction failure that causes a positional displacement or a backlash of the third contact. Since the position of the third contact is stabilized, it is possible to stabilize contact resistance between the first contact and the second contact. It is also possible to suppress chattering caused by vibration.

In the invention, it is possible to reliably retain the third contact at the original position, while allowing a displacement of the first portion and the second portion to the above-described normal direction.

In the invention, it is possible to reduce the dimension of the third contact in the normal direction, while sufficiently ensuring flexibility of the first portion and the second portion. Therefore, such a configuration contributes to the reduction in size of the slide switch.

In the invention, it is possible to reduce the dimension of the slide switch in the normal direction. That is, it is possible to make the slide switch thin.

In the invention, regardless of the position of the slider, it is possible to retain the third contact at the original position.

According to the invention, it is possible to prevent defects such as a conduction failure, even when the sizes of parts that configure the slide switch are reduced.

What is claimed is:

1. A slide switch, comprising:

a case forming an accommodation space;  
a first contact disposed in the accommodation space;  
a second contact disposed in the accommodation space;  
a third contact disposed in the accommodation space; and  
a slider fixed to the third contact, wherein

the slider is movable between a first position in which the first contact and the second contact are electrically insulated from each other and a second position in which the first contact and the second contact are electrically connected to each other via the third contact,

the case includes a projection supporting the third contact in a normal direction of a plane which includes a moving path of the slider in the accommodation space,

the third contact includes a first portion, a second portion,  
and a third portion,  
the first portion and the second portion are displaceable in  
the normal direction of a plane which includes a moving  
path of the slider in the accommodation space, and 5  
the projection in the case restricts a movement of the third  
portion of the third contact in the normal direction.

2. The slide switch according to claim 1, wherein  
the third portion is disposed between the first portion and  
the second portion and fixed to the slider, and 10  
the projection supports the third portion.

3. The slide switch according to claim 2, wherein  
the third portion extends so that a longitudinal direction of  
the third portion is a movement direction of the slider,  
the first portion is supported in a cantilever beam form in a 15  
first end portion in the longitudinal direction of the third  
portion,  
the second portion is supported in a cantilever beam form  
in a second end portion in the longitudinal direction of  
the third portion, 20  
the first portion extends from the first end portion to the  
second end portion, in one direction, and  
the second portion extends from the second end portion to  
the first end portion, in one direction.

4. The slide switch according to claim 1, wherein 25  
a recess portion recessed in the normal direction is formed  
on the slider, and  
the third contact and the projection is disposed in the recess  
portion.

5. The slide switch according to claim 1, wherein 30  
the projection extends across the overall movable range of  
the slider along a movement direction of the slider.

\* \* \* \* \*